MITIGATING FERTILIZER RUNOFF FROM NURSERY PRODUCTION FACILITILIES

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Overview

- Media and Substrates
- Plant Nutrition and Fertilizers
- Irrigation and Water Management

Quick Review

- Water Holding Capacity (WHC)
- Hydrophobic – Hydrophilic Properties
- Cation Exchange Capacity
- Shrinkage/Stability
- Aeration
- Sterilization
- Media/Substrate Types

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Water Holding Capacity (WHC)

- Substrate blends should be selected to retain water, but provide pore spaces for aeration.

*WHC of most ideal substrates and media usually range between 25-40 %.

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Silt and clay add WHC, but cause aeration problems and will slowly leach out in runoff, clogging container bottoms and drainage basins.

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Increasing WHC increases the ability of the media to hold dissolved nutrients at the roots, instead of leaching out of containers.

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Hydrophilic – Hydrophobic Properties

•Some substrates, such as dry peat, will repel water. To correct or avoid this problem:

*Never allow medium to dry out completely if it contains hydrophobic substrates

*Add a surfactant to increase wettability.

*Blend peat with another substrate, such as sand, coir or bark products to minimize hydrophobic properties.

*Provide irrigation that uniformly wets media throughout container.

Do not rewet dry hydrophobic substrates through irrigation. This will cause excess water usage and nutrient runoff if fertilizer is in the irrigation water.

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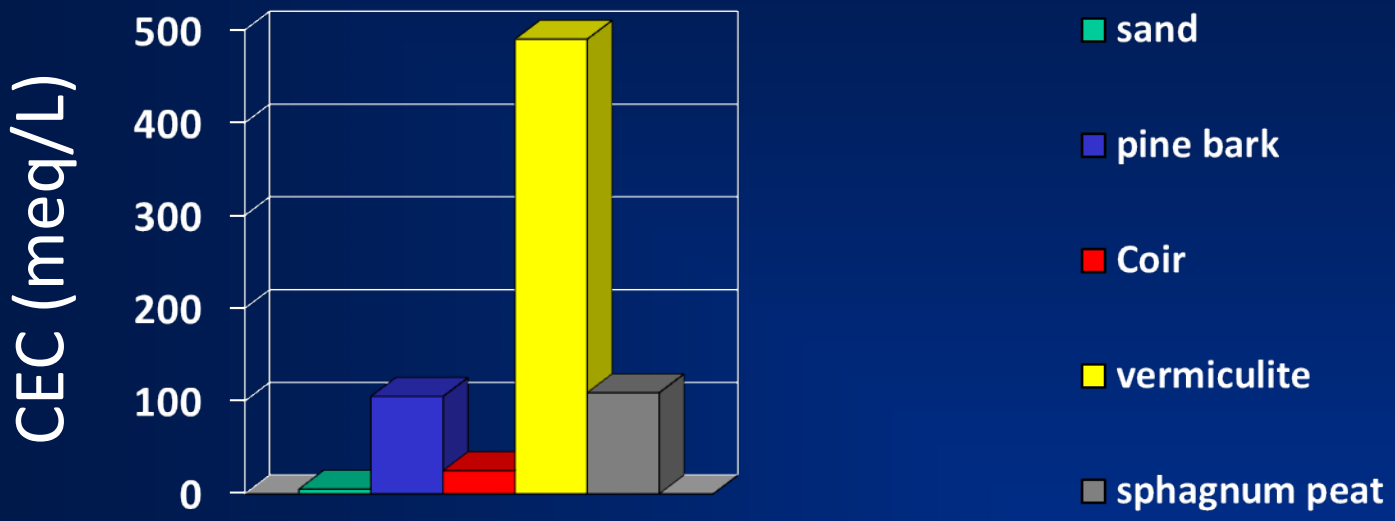
Cation Exchange Capacity (CEC)

The total amount of positively charged ions that a substrate can adsorb



The Anion Exchange Capacity (AEC), the amount of negatively charged ions that can adsorb onto the substrate , is about 1-5% of the CEC for most media ~ almost nonexistent. This is the reason anions, such as nitrates and phosphates, easily leach out of media and soils and are a problem in watershed management.

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Media Shrinkage

Media ‘shrinkage’ is the loss in volume of the media because organic products decay quickly or clay leaches out of containers.

Wood products with high cellulose content break down quickly, rather than barks and products that contain lignins and tannins

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Media that breaks down `shrinks‘ will increase potential of nutrient runoff because:

1) nutrient storage capacity of media is reduced.
2) WHC of media is reduced.
3) root volume potential is reduced.

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Aeration

- Substrate blends should be formulated to provide oxygen in the root zone.

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Proper aeration is required for respiration of the root system. A healthy root system optimizes nutrient uptake potential.

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Substrate Types

- **Organic amendments and substrates**

*Manures do not provide slow release of nutrients. Nutrient release is quick.

*Barks do not provide nitrogen or phosphorus and could actucually tie up nutrients.

*Wood products, like sawdust and ground pallets, break down quickly and tie up nutrients.

*Rice hulls and shells breakdown slowly.

Mulches such as barks and wood do not add nitrogen to the soil. In fact, these products add so much carbon, that additional nitrogen may be needed, as wood decomposition is a sink for nitrogen.

Manures add nitrogen, phosphorus and other nutrients, so this can increase the risk of nitrogen and phosphorus in runoff.

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Substrate Types

- **Inorganic amendments and substrates**

*Sand and silts help with drainage, but smaller particle sizes may reduce drainage.

*Clays will move to bottom, and will either clog containers or will cause milky suspension in water.

*Vermiculite, a superheated mineral, excellent WHC, aeration, CEC but easily smashed or compressed if handled improperly.

*Calcined clays, provide WHC , CEC, and aeration

Sands, if too fine, will reduce drainage and porosity. This will inhibit root growth and increase the risk of nutrient leaching and runoff.

Clays , while contributing to CEC, usually percolate to contaioner bottoms and cause reduced drainage. Consider calcined clays instead to increase CEC and mitigate nutrient runoff.

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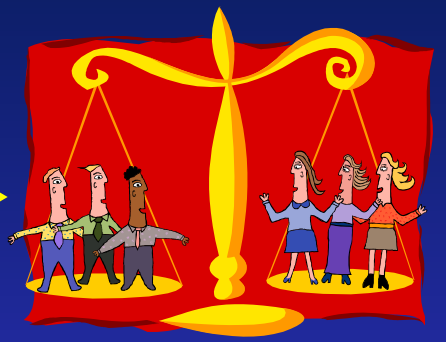
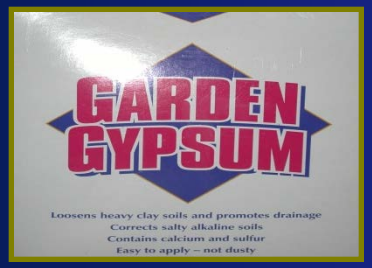
Plant Nutrition and Fertilizer Management Q-B-T-M-S

- Quantity
- Balance
- Timing
- Mobility
- Source





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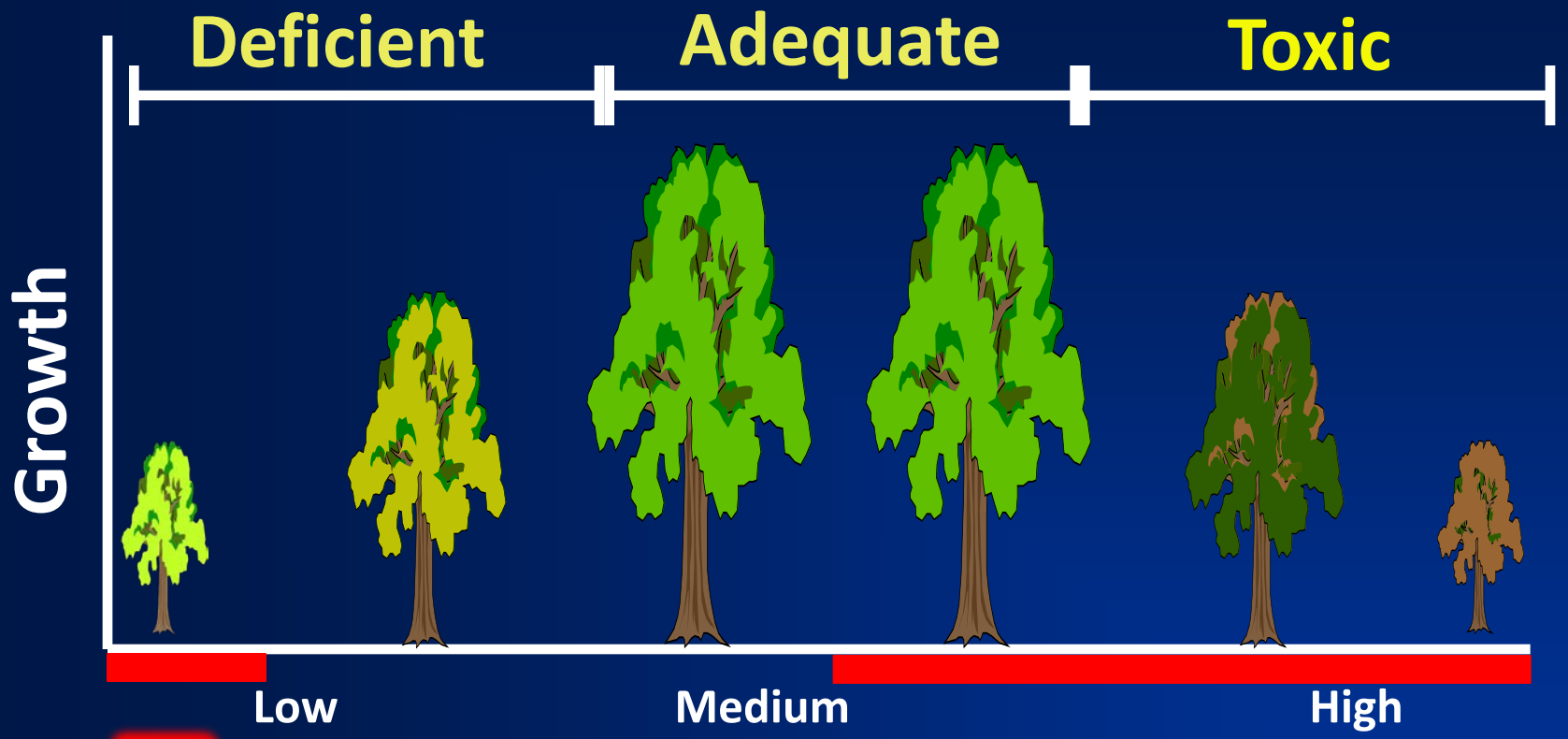
Fertilizer Quantity



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= zone of increased risk of nutrient runoff/leaching

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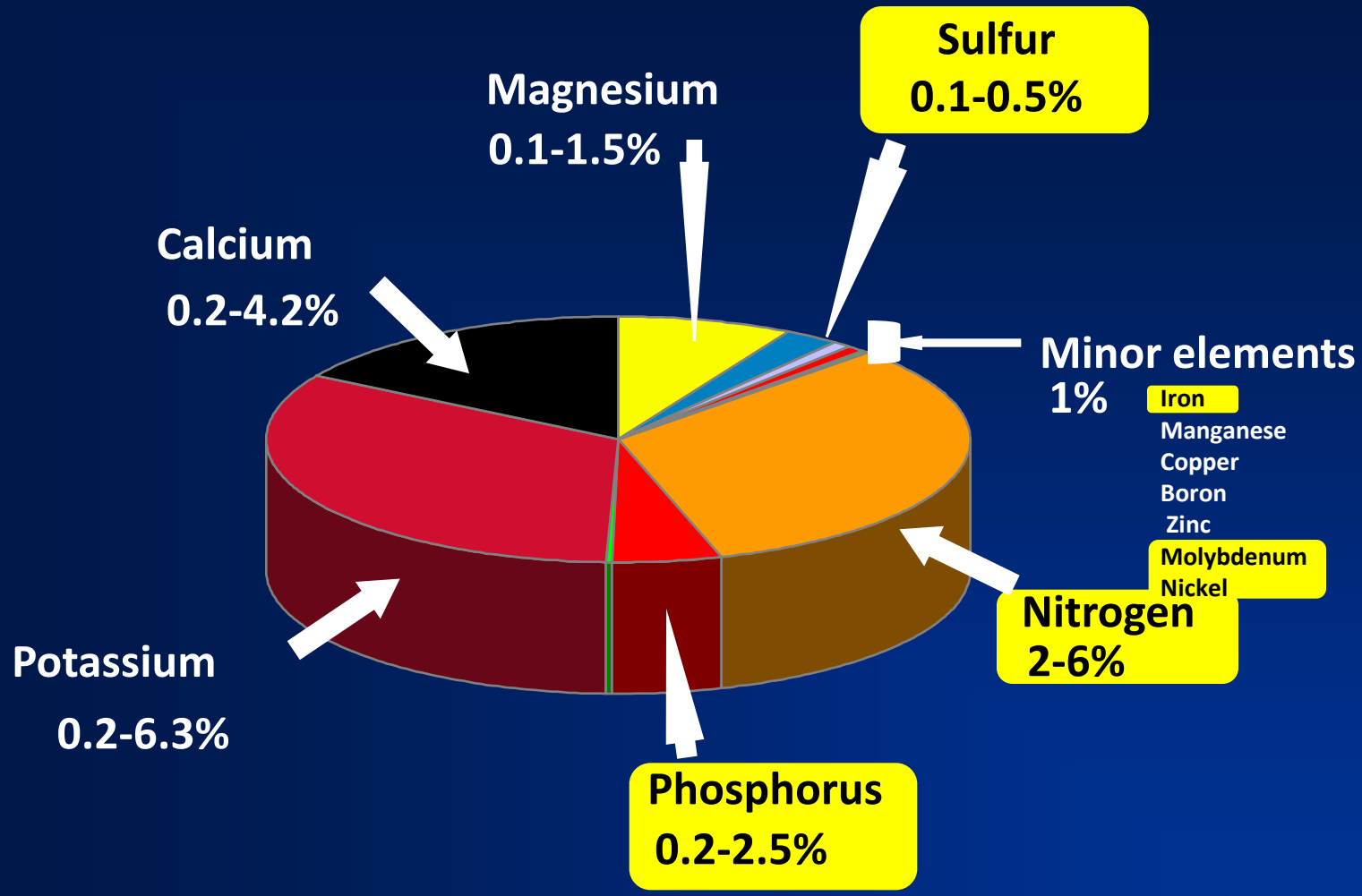
Fertilizer Balance



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Balanced availability of nutrients will optimize nutrient uptake efficiency in a plant system.

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Timing of Fertilizer Applications

Seasonal Variability

- Spring vs. summer – in conjunction with plant growth
- Winter rains vs. summer droughts – leaching with winter rains

Stage of Plant Development

- Active vegetative growth and flowering seedlings vs. mature plants

Cultural management

- pruning
- transplanting

Plant Health – roots vs. shoots

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Nutrient Mobility in the Plant

Mobile

- Nitrogen
- Phosphorus
- Potassium
- Magnesium
- Molybdenum
- Nickel

Immobile

- Calcium
- Sulfur
- Iron
- Manganese
- Boron
- Copper
- Zinc
- *Molybdenum
- *Nickel

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Know how to diagnose nutrient disorders

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Fertilizer Source
for one element

* **Solubility -** Fe-chelates vs. Fe-sulfates or Fe-oxides

***pH stability –** nitrates, Ca-carbonates increase pH, ammonium decreases pH.

***Nutrient interactions -** mixing

Proper fertilizer selection will optimize nutrient uptake and minimize runoff potential

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Quick Review

- Granular Fertilizers
- Liquid Fertilizers

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Granular Fertilizers

1. Uncoated Granular

2. Coated Granular
   (Controlled Release Fertilizers)

3. Organic– i.e. ureas, manures

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Granular Fertilizers

Nutrient release/solubility is based on several factors of the FERTILIZER:

1. **Solubility of the fertilizer compound**
2. **Size of the fertilizer granule/prill**
3. **Release characteristics of coating on coated Fertilizers**

Read labels! For coated fertilizers, usually all or part of the nitrogen source is coated. Also, other nutrients may or may not be coated.

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Granular Fertilizers

Nutrient release/solubility is based on several factors of the ENVIRONMENT:

1. **Temperature** –>
2. **Moisture**
3. **Other 'salts' in water**

Read labels! For coated fertilizers, usually all or part of the nitrogen source is coated. Also, other nutrients may or may not be coated.

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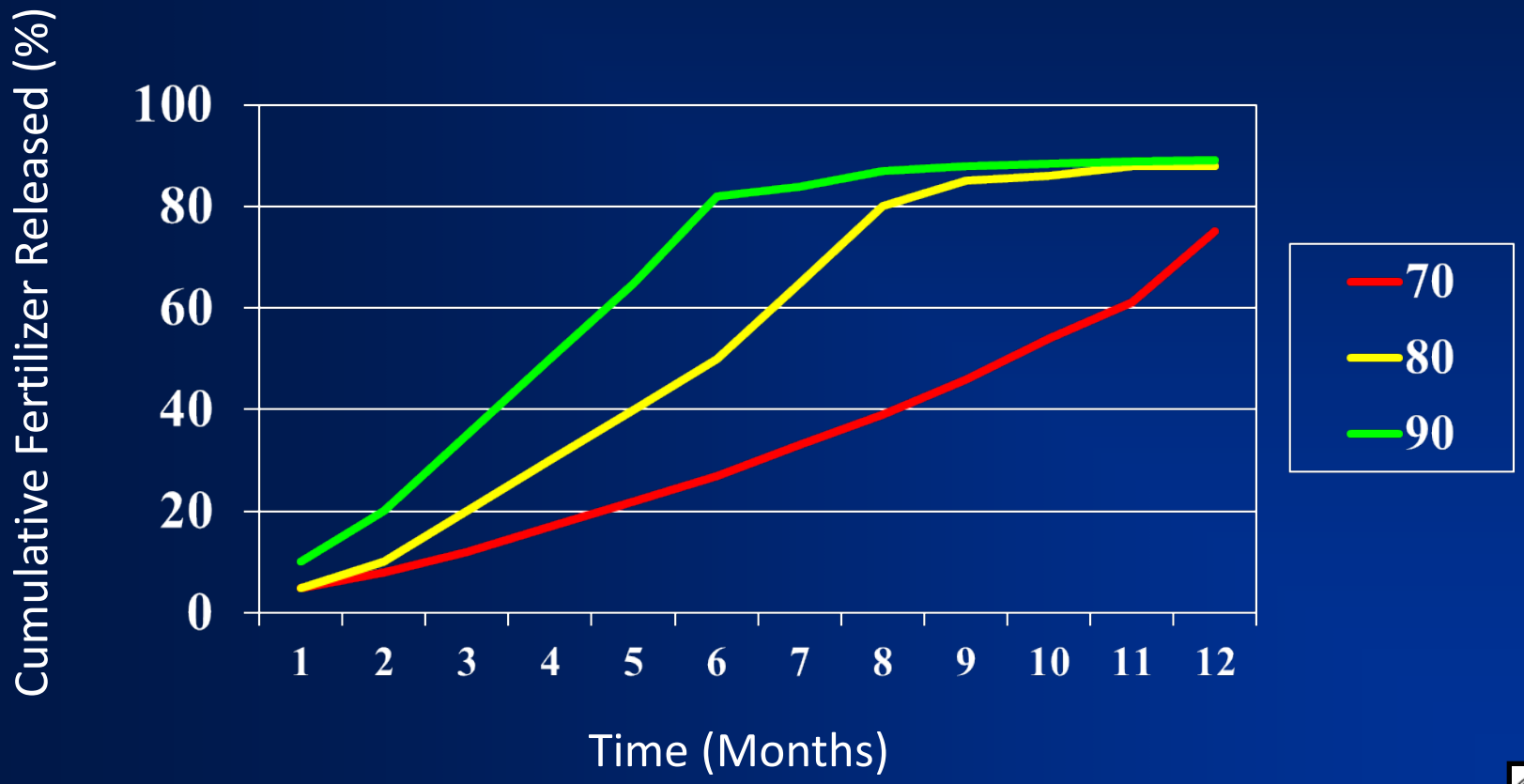
Granular Fertilizers
Controlled Release Fertilizers (CRF)

Nutrient release rate and duration of fertilizer release is based on coating thickness or coating type

***Release rates increase with increasing temperature and/or moisture**



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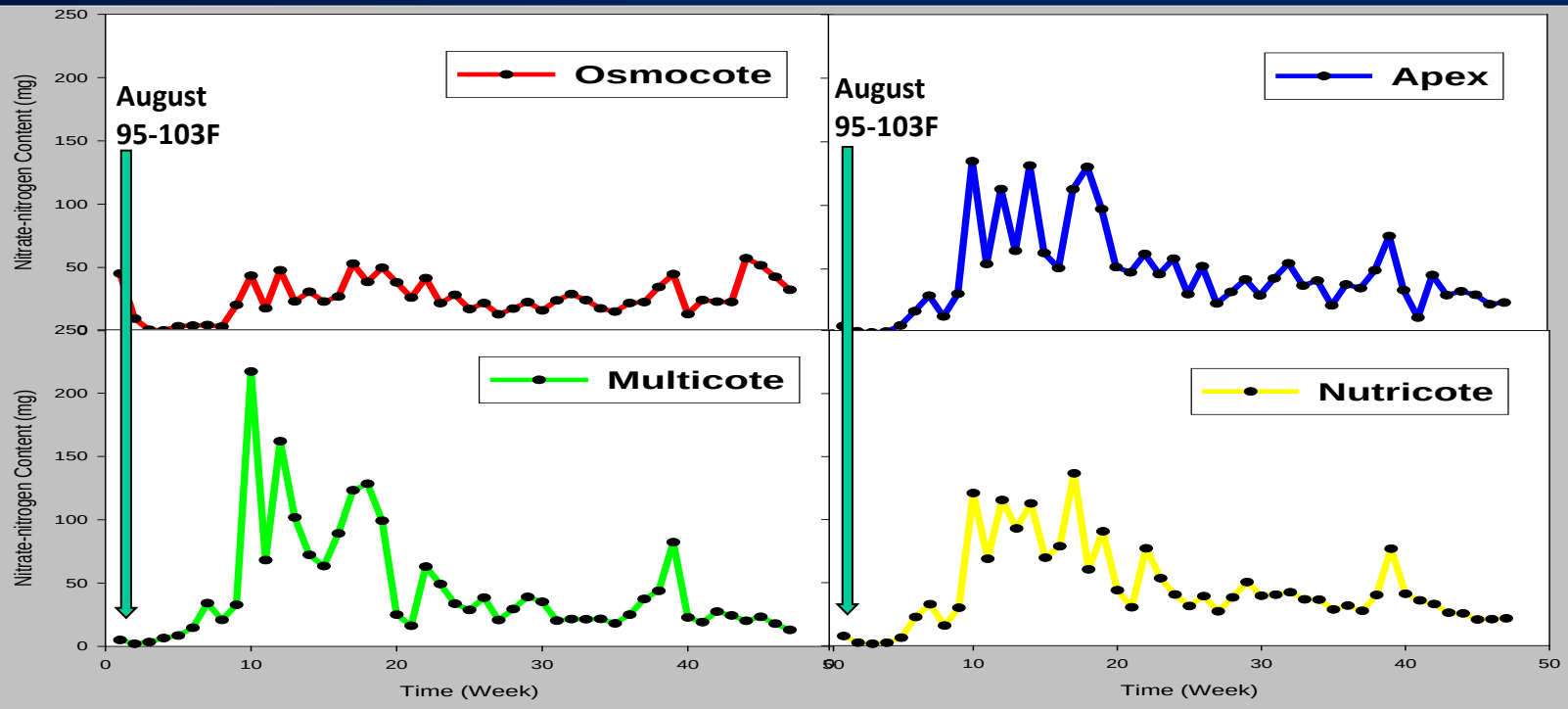
Controlled Release Fertilizers
Nitrate-Nitrogen in Leachate in 12 month product

+Nutrient release minimal after planting – favorable, because few roots in beginning
+Release moderate during warm months, then lower in cool months.

Planting during cooler months will help optimize nutrient release in conjunction with root establishment. (Goal = Get root development before nutrient release). Cool coastal nurseries less affected than warm inland nurseries.



Granular Fertilizers
*Organic

***Carbon-based compounds. Examples: urea, sulfur-coated urea (SCU), isobutylidene diurea (IBDU), bone meal, blood meal, guano**

Release rates based on:

1. **microbial activity**
2. **temperature**
3. **media characteristics**

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Organic ≠ Slow Release. Nutrient release rates can be very quick in some products and very slow for other products.

Fast – nitrogen in manures
Slow – phosphorus in bone meal

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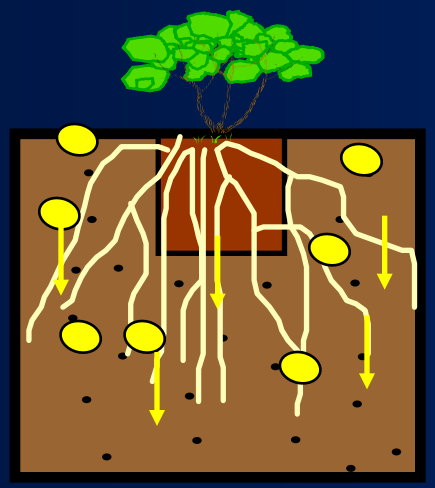
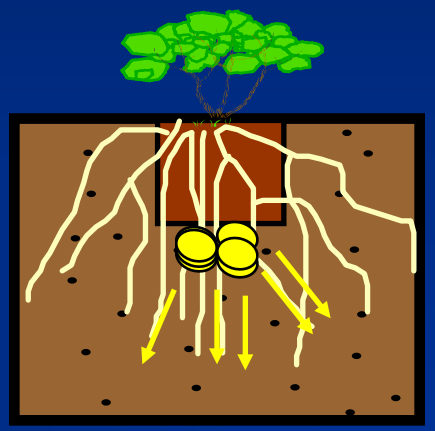
Granular Fertilizers Application Methods

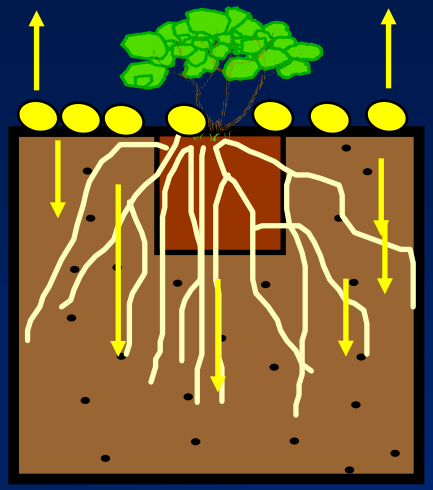
1. Topical
2. Dibble
3. Layered
4. Blended





Topical Applications

- Fertilizer



+ Fertilizer percolates down through entire container intercepting most roots.

-Volatilization of nitrogen

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Do not broadcast over a bed of containers.
Make separate application to each container.

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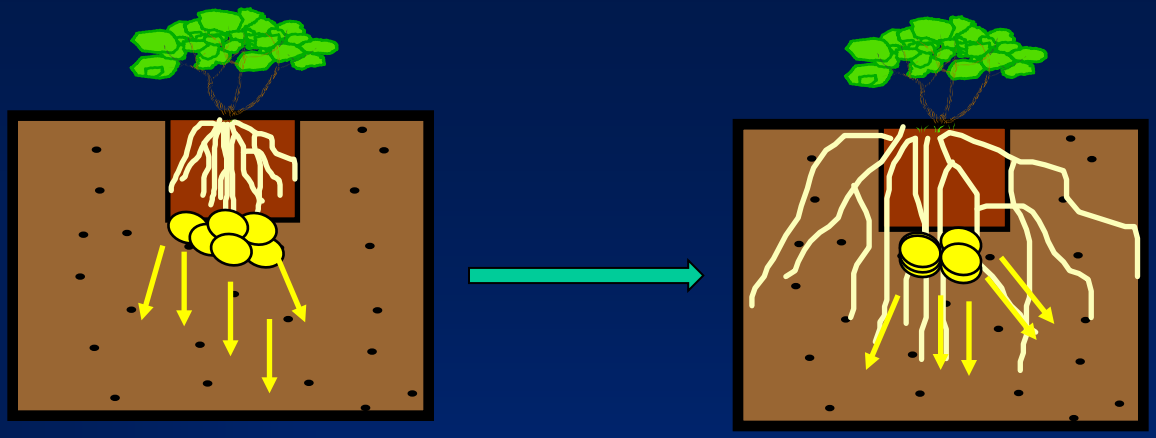
Dibble Applications

- Fertilizer



\+ No (little) nitrogen volatilization

\- Fertilizer not always in contact with roots

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Careful management of irrigation especially critical until root establishment can intercept nutrient release from fertilizer

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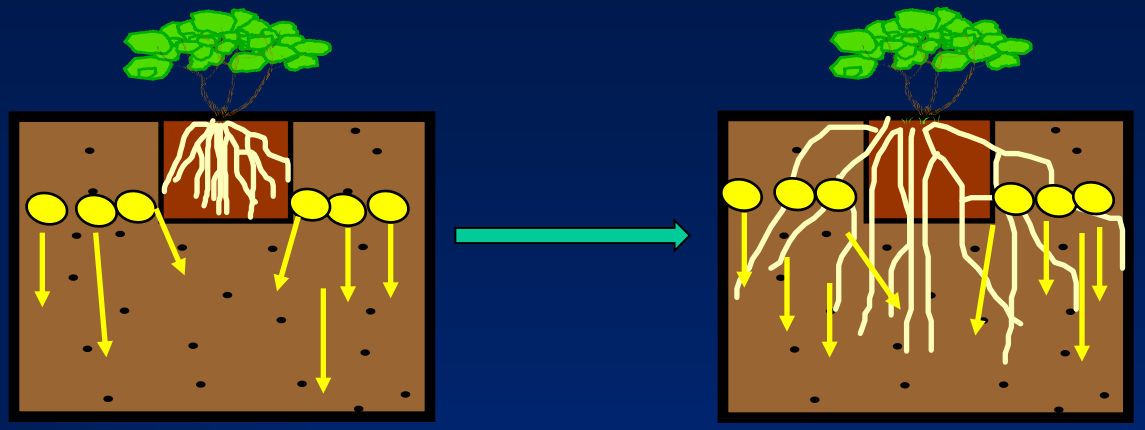
Layered Applications

- Fertilizer



+ No (little) nitrogen volatilization

- Fertilizer not always in contact with roots

BMP

Careful management of irrigation especially critical until root establishment can intercept nutrient release from fertilizer

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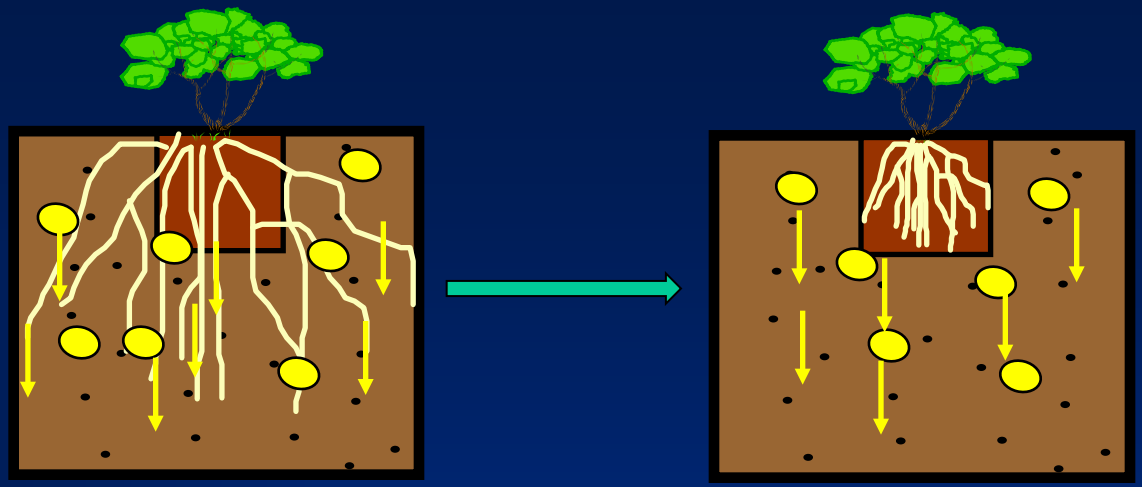
Blended Applications

- Fertilizer



+ no (little) nitrogen volatilization

-fertilizer not always in contact with roots

BMP

Do not store media containing fertilizers since high temperatures will increase release rates of nutrients from fertilizer.

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Careful management of irrigation especially critical until root establishment can intercept nutrient release from fertilizer.

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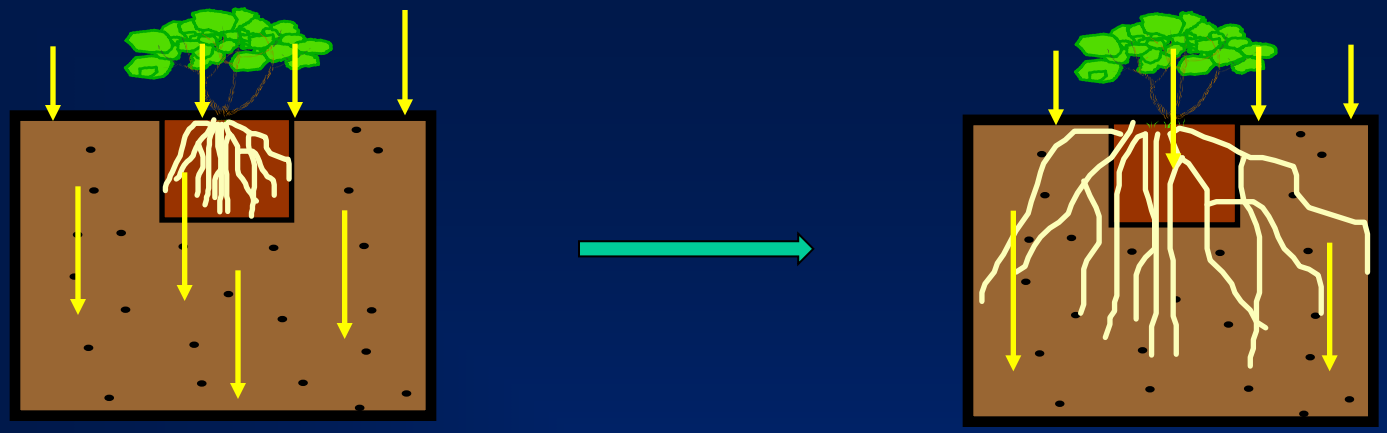
Fertigation



+ no (little) nitrogen volatilization

+ fertilizer applied when needed

+fertilizer usually in contact with roots

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Do not irrigate excessively since dissolved fertilizer is easily leached from medium.

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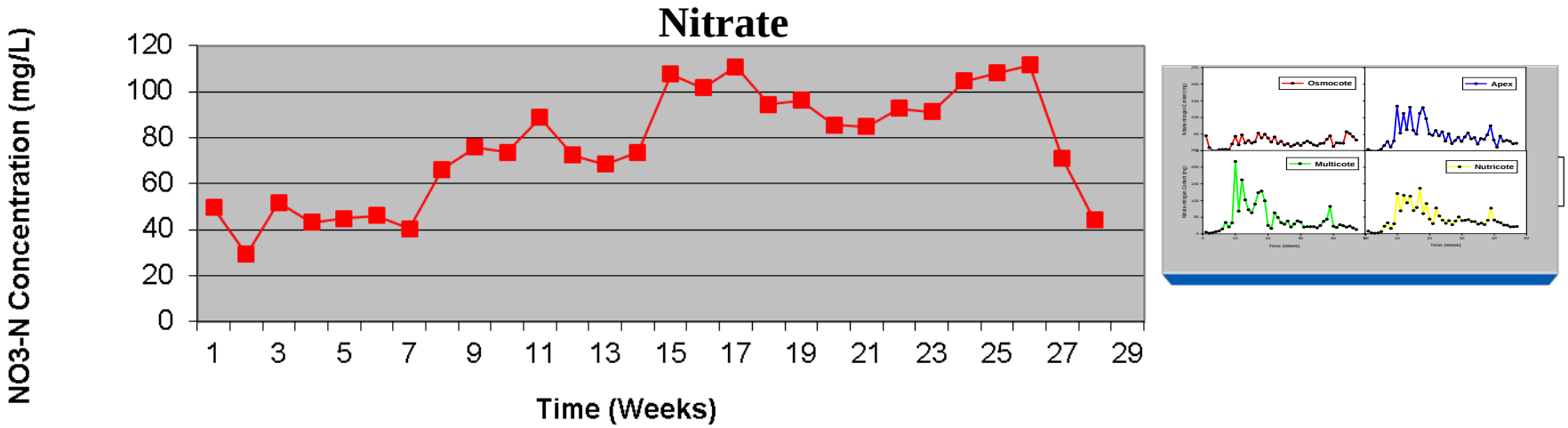
Uniform Nutrient Availability

Leachate Nitrate-Nitrogen Concentration from Media Fertilized with Nitrate



- NO_3 LEACHING
- 1st 10 weeks
  - conversion to ammonium
  - media binding
  - carbon/nitrogen balance

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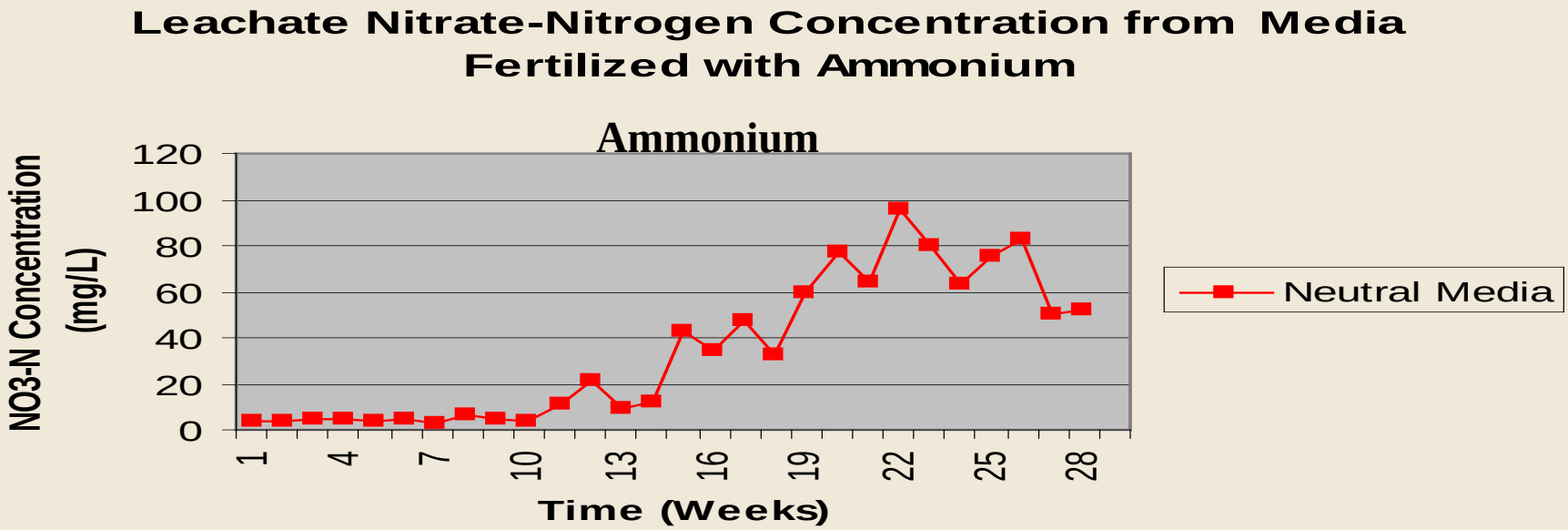
Nitrification



- **NITRATE LEACHING**

1st 10 weeks

ammonium-soil binding

carbon/nitrogen balance

2nd 20 weeks

nitrification

Liquid Fertilizers
BMPs

Read Directions and labels and consider nutrient solubility of fertilizers

Fertilizer solubility is less with colder water temperatures

Check solubility of fertilizer in a water sample and/or consult with a product representative or Farm Advisor, since variables such as water temperature, electrical conductivity and pH and influence fertilizer solubility

Irrigation Practices. Drip irrigation into containers is optimum as all fertilizer will come in contact with the root system. Overhead irrigation should only be done if water capture and recycling systems are in place

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Irrigation Methods

1. Overhead – impact, boom
2. Hand watering
3. Drip/Microspray
4. IrrigationSubirrigation/Capillary mats/Flood Irrigation
5. Hydroponic systems

Water capture and recycling will minimize or eliminate runoff for all irrigation methods.

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Irrigation Methods

1. Overhead – impact, boom

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Conduct Uniformity of Distribution test

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Closer container spacing will optimize interception of irrigation and minimize runoff

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Irrigation Methods

2. Hand watering

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Train employees and use high-performance nozzles

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Irrigation Methods

3. Drip/microsprays

BMP Optimize pressure in lines for system being used

BMP Turn off individual drippers if plant is missing or dead

BMP Check lines regularly for clogging and rodent chewing

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Irrigation Timing

1. Pulse irrigation
2. Time of Day
3. Seasonal considerations

Pulse irrigation – short irrigation episode prewets media, especially if medium is slightly hydrophobic

Time of Day – nights and no wind reduce evaporation loss with overhead irrigation, but watch foliar diseases with night wetness on foliage.

Seasonal – lower radiation levels during short days means lower evapotranspiration, even with high temperatures.

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